Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/ 3700-4200 MHz Bands and 14.0-14.5 GHz/ 11.7-12.2 GHz Bands	)	IB Docket No. 02-10

REPORT AND ORDER

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By the Commission: Chairman Powell issuing a statement.

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I. INTRODUCTION

1. In this *Report and Order*, we establish licensing and service rules for Earth Stations on Vessels (ESVs) operating in the 5925-6425 MHz/3700-4200 MHz (C-band)[1] and 14.0-14.5 GHz/11.7-12.2 GHz (Ku-band) frequencies.[2] ESVs have been utilized for the past several years to provide telecommunications services, including internet access, to cruises, merchant ships, ferries, barges, yachts,

[1] The 5925-6425 MHz band also is known as the C-band uplink or 6 GHz band; the 3700-4200 MHz band also is known as the C-band downlink or 4 GHz band. The C-band uplink and downlink are allocated to the fixed service (FS) and the fixed-satellite service (FSS) on a co-primary basis. The 5925-6425 MHz band is densely used by the fixed point-to-point microwave service.

[2] The 14.0-14.5 GHz band also is known as the Ku-band uplink or 14 GHz band; the 11.7-12.2 GHz band also is known as the Ku-band downlink or 12 GHz band. The Ku-band uplink and downlink are allocated to the FSS on a primary basis. We also include a portion of the extended Ku-band (10.95-11.2 GHz and 11.45-11.7 GHz) in our decision today.

and U.S. navy vessels – *i.e.*, any marine craft large enough to meet reasonable size requirements and safely carry a stabilized satellite dish. In our decision today, we allow ESV operations to continue in the C- and Ku-bands, while ensuring that ESVs protect fixed services (FS), fixed-satellite service (FSS) operators, and a limited number of Government operations in these bands from harmful interference.

2. Specifically, we impose certain technical conditions on ESV operations as an application of the FSS with mobile capabilities. In allowing ESVs to continue operations in the C-band, it is our goal to strike the appropriate balance of ESV and FS interests by adopting operational requirements for ESVs in the C-band that will ensure that incumbent and future FS operators are protected from harmful interference. For example, ESVs in the C-band must coordinate spectrum use, adhere to limits on the amount of coordinated spectrum and number of satellites, and comply with a minimum vessel size. We impose fewer operational restrictions in the Ku-band than in the C-band because ESVs are less likely to cause harmful interference to incumbent services in that band. We continue to allow ESV C-band use because the C-band has certain beneficial characteristics not available in the Ku-band. At the same time, we encourage ESV operators to utilize the Ku-band for their operations wherever possible through enhanced rights and limited regulation in that band. Given the relatively limited presence of FS users in the 11.7-12.2 GHz band and our belief that the proliferation of Ku-band satellites is making Ku-band spectrum more accessible and reliable, we view the Ku-band as an ideal operational environment for future ESV growth, particularly for use on inland waterways.

3. In both the C- and Ku-bands, we require ESV operators to protect FSS incumbents through limits on off-axis effective isotropically radiated power (e.i.r.p.) density and to cease operations if the ESV antenna drifts more than 0.5 degrees from the target satellite. We also require operators in both bands to collect and maintain vessel tracking data to assist in identifying and resolving sources of interference. In addition, we add footnotes to the U.S. Table of Frequency Allocations to recognize ESVs as an application of the FSS with primary status. In doing so, we implement, in part, the decision reached at the International Telecommunication Union's (ITU's) 2003 World Radiocommunication Conference (WRC-03), which added a footnote to the International Table of Frequency Allocations stating that, in the 5925-6425 MHz and 14.0-14.5 GHz bands, ESVs may communicate with FSS space stations. We also provide for system licensing (consisting of ESV hub stations and/or blanket licensing for ESV earth stations) in order to give both C- and Ku-band ESV operators greater flexibility in structuring their operations. Finally, consistent with ITU encouragement of administrative cooperation in reaching agreements on the use of ESV systems,[3] we establish a regulatory framework that will enable foreign-licensed ESVs to operate near the United States without causing harmful interference to domestic operations.

4. Licensing ESV operations advances the Commission's goals and objectives for market-driven deployment of broadband technologies. Broadband technologies encompass all evolving high-speed digital technologies that provide consumers integrated access to voice, high-speed data, video-on-demand, and interactive delivery services, which are becoming a fundamental component of modern communications.[4] The maritime market for broadband via satellite-based communications continues to expand. For example, the U.S. cruise ship industry, a primary user of these communications, has grown

[3] *See Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5925-6425 MHz and 14-14.5 GHz*, The World Radiocommunication Conference (Geneva, 2003) (ITU-R Resolution 902 (WRC-03)).

[4] *See* Federal *Communications Commission Strategic Plan FY 2003-FY 2008, Means and Strategies to meet Goal 1 - Broadband*, page 10, (visited Dec. 13, 2004) <http://www.fcc.gov/omd/strategicplan/strategicplan2003-2008.pdf>.

in recent years.[5] More recently, broadband-based services via satellites became available to students taking academic courses at sea.[6] As ESV operators deploy increasingly innovative broadband services to their subscribers, the rules we adopt today help to assure that, through ESVs, broadband services are available to businesses and consumers on the high seas, coastlines, and inland waterways.

II. BACKGROUND

A. Initial ESV Authorization and Operation

5. In December 1991, Crescomm Transmission Services, Inc. (Crescomm) filed a Petition for Rulemaking to allow it to provide communications to ships via satellite in the C- and Ku-bands.[7] In its Petition, Crescomm proposed to provide satellite-based mobile telecommunications services to vessels in frequencies that are allocated to FSS and terrestrial FS, and requested a blanket license for Very Small Aperture Terminal (VSAT) ESVs.[8] In 1996, the International Bureau (the Bureau) and the Office of Engineering and Technology (OET) issued the *Crescomm Order*, granting a waiver of the Commission's rules that would allow Crescomm to provide its proposed shipboard services in the C- and Ku-bands on a non-conforming use basis, subject to Crescomm filing for and receiving appropriate licensing authority and/or Special Temporary Authority (STA).[9] The *Crescomm Order* required Crescomm to protect against interference to, and accept interference from, any radio services allocated in the bands, and to operate only beyond 100 kilometers (km) (approximately 60 miles) from the U.S. coastline unless Crescomm successfully coordinated its operations with all affected terrestrial FS operators.[10]

6. Maritime Telecommunications Network (MTN), Crescomm's successor-in-interest,[11] applied for and received its first STA to operate ESVs in the C-band on 45 vessels traveling more than 100 km from the U.S. coastline, commencing January 30, 1997.[12] During 1997, MTN's STA was expanded to

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[5] *See* Don Walsh, *Tourism and Terrorism: A Difficult Journey Ahead for the Cruise Ship Industry*, (visited Dec. 13, 2004) <http://www.navyleague.org/sea_power/dec_02_51.php>.

[6] *See Maritime Telecommunications Network Joins Institute for Shipboard Education to Deliver Wireless Internet Access and OceanNews to Semester at Sea*, (visited Dec. 13, 2004) <http://www.mtnsat.com/press/2002/pressrelease_100202_semesteratseaprogram.htm >.

[7] Crescomm Transmission Services, Inc., Petition for Rule Making Request for Pioneer Preference, RM-7912 (filed Dec. 12, 1991) (*Crescomm Petition*).

[8] *Id.* at 1.

[9] *See Mobile Satellite-Based Communications Services by Crescomm Transmission Services, Inc. and Qualcomm Incorporated*, Order, DA 96-650, 11 FCC Rcd 10944, 10948, ¶ 9 & 10949-50, ¶ 12 (Int'l Bur./OET 1996) (*Crescomm Order*). Qualcomm requested and received a waiver of the Table of Frequency Allocations to allow it to provide satellite-based communications to ships in the 12/14 GHz band, via a satellite-based land mobile data system known as OmniTRACS.

[10] *Id.* at 10948-49, ¶¶ 10-11. For the purposes of our ESV rules, "coastline" is synonymous with "baseline," which we define as a combination of the low-water line and closing lines across the mouths of inland water bodies, adjusted from time-to-time by the U.S. Department of State's Baseline Committee. *See infra* footnote 69 & Appendix B (new definitions added to 47 C.F.R. § 25.201).

[11] *Crescomm Order*, 11 FCC Rcd at 10944 n.2.

[12] *See Maritime Telecommunications Network, Inc.*, Order, DA 00-1300, 15 FCC Rcd 23210, 23212, ¶ 4 (Int'l Bur. 2000) (*MTN Order*), *modified*, Order, DA 00-2263, 15 FCC Rcd 19572 (Int'l Bur. 2000), *recon. denied*, Order on Reconsideration and Memorandum Opinion and Order, DA 01-1283, 16 FCC Rcd 11615 (Int'l Bur. 2001) (*MTN Reconsideration Order*). The initial STA expired on July 30, 1997.

allow MTN to operate the ESVs in or near seventeen U.S. ports on a non-harmful interference basis.[13] The Bureau granted MTN's requests to extend the STAs several times from 1997 through 2000.[14] In a January 2000 request to extend its STAs, MTN requested authority to increase the number of vessels equipped with its ESVs.[15] The Bureau granted the STA extension request only as it pertained to U.S.-registered ships, declined to grant STAs for foreign-registered ships, and dismissed without prejudice MTN's request to expand its authority to additional ships.[16] As a result, the Bureau permitted the MTN network to operate ESVs on six U.S. Navy vessels to and from seventeen U.S. ports on a non-harmful interference basis, and also permitted MTN to operate those ESVs at sea beyond 100 km from the U.S. coastline.[17] In 2001, while in the process of converting the C-band ESVs to the Ku-band, MTN requested an STA to operate ten ESVs on U.S.-flagged vessels in the C- and Ku-bands.[18] The Bureau granted that request from July 20, 2001 until September 20, 2001,[19] and renewed a later request for sixty days from September 21, 2001 until November 20, 2001.[20] Subsequent STA requests by MTN have been for the Ku-band only.[21]

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[13] *MTN Order*, 15 FCC Rcd at 23212, ¶ 4 & nn.13-14.

[14] *See, e.g.*, Letter from Helen Disenhaus, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated July 22, 1999) (STA authorization renewed by grant-stamp from July 30, 1999 until January 30, 2000); Letter from Helen Disenhaus, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated Jan. 22, 1999) (STA authorization renewed by grant-stamp from January 30, 1999 until July 30, 1999); Letter from Helen Disenhaus, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated July 17, 1998) (STA authorization renewed by grant-stamp from July 30, 1998 until January 30, 1999); Letter from Helen Disenhaus, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated Jan. 27, 1998) (STA authorization renewed by grant-stamp from January 30, 1998 until July 30, 1998); Letter from Eliot Greenwald, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated Jan. 25, 1997) (STA authorization renewed by grant-stamp from July 30, 1997 until January 30, 1998).

[15] *MTN Order*, 15 FCC Rcd at 23213, ¶ 5. *See also* Letter from Helen Disenhaus, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated Jan. 27, 2000).

[16] *MTN Order*, 15 FCC Rcd at 23214, ¶ 8. In declining to grant STAs for the foreign-registered vessels, the Bureau stated that, pursuant to Section 306 of the Communications Act, the Commission does not have jurisdiction to license ESVs on foreign vessels. The Commission also began to investigate ways to coordinate transmissions from these foreign-registered ships or to have separate bilateral agreements with the countries involved in order to protect domestic terrestrial fixed services. *Id.* at 23214-15, ¶ 9.

[17] *Id.* at 23217, ¶¶ 16-17. *See also MTN Reconsideration Order*, 16 FCC Rcd at 11630-31, ¶¶ 48-51 (affirming the *MTN Order* and extending MTN's STA with regard to the six U.S. Navy vessels through December 1, 2001).

[18] Letter from Eliot J. Greenwald, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated July 6, 2001).

[19] *See id.* The Bureau stated that the authorization was subject to the conditions set forth in the *MTN Reconsideration Order*, 16 FCC Rcd 11615 (reiterating that the STAs only apply to U.S.-registered vessels).

[20] *See* Letter from Eliot J. Greenwald, Counsel for MTN, to Magalie Roman Salas, Secretary, FCC (dated Sept. 18, 2001).

[21] *See* Letter from Raul Rodriguez, Counsel for MTN, to the International Bureau, FCC (dated June 10, 2004) (STA authorization renewed by grant-stamp from June 18, 2004 until Dec. 14, 2004); Letter from Raul Rodriguez, Counsel for MTN, to the International Bureau, FCC (dated Dec. 9, 2003) (STA authorization renewed by grant-stamp from Dec. 17, 2003 until June 17, 2004); Letter from Raul Rodriguez, Counsel for MTN, to the International Bureau, FCC (dated June 11, 2003) (STA authorization renewed by grant-stamp from June 20, 2003 until Dec. 16, 2003); Letter from Raul Rodriguez, Counsel for MTN, to the International Bureau, FCC (dated Jan. 15, 2003) (STA authorization renewed by grant-stamp from January 19, 2003 until June 19, 2003); Letter from Raul Rodriguez, Counsel for MTN, to the International Bureau, FCC (dated Nov. 13, 2002) (STA authorization renewed by grant-stamp from November 19, 2002 until January 19, 2003); Letter from Eliot Greenwald, Counsel for MTN, to Marlene H. Dortch, Secretary, (continued....)

B. International Framework for ESVs

7. The 2000 World Radiocommunication Conference in Istanbul (WRC-2000) adopted Resolution 82, which recognized the ability of ESV licensees to operate using C-band as well as Ku-band FSS networks.[22] Passage of this Resolution prompted the International Telecommunication Union's Radiocommunication Sector (ITU-R) to study the potential for interference from ESVs to FS operations. In particular, the ITU-R Joint Working Party 4-9S (JWP-4-9S), which studies FSS and FS sharing issues, developed several recommendations pertaining to ESV operations.[23] These recommendations described methods that can be used to minimize interference to FS services from ESV operations.

8. At WRC-03, a footnote was added to the International Table of Frequency Allocations stating that in the 5925-6425 MHz and 14.0-14.5 GHz bands ESVs may communicate with space stations in the FSS.[24] WRC-03 established minimum distances from the low-water mark as officially recognized by the coastal state beyond which ESVs can operate without the prior agreement of any administration: 300 km (approximately 180 miles) in the 5925-6425 MHz band and 125 km (approximately 75 miles) in the 14-14.5 GHz band.[25] These minimum distances are conditioned upon technical limitations, such as antenna size and off-axis e.i.r.p. and e.i.r.p.-density limits towards the horizon for ESV stations.[26] The limitations on maximum e.i.r.p. spectral density towards the horizon and maximum e.i.r.p. towards the horizon were adopted by the Conference as a method for protecting incumbent fixed services. The

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FCC (dated June 4, 2002) (STA authorization renewed by grant-stamp from May 18, 2002 until November 18, 2002); Letter from Eliot Greenwald, Counsel for MTN, to Ronald Repasi, International Bureau, FCC (dated Nov. 16, 2001) (STA authorization renewed by grant-stamp from November 20, 2001 until May 18, 2002).

[22] Provisions Relating to Earth Stations Located on Board Vessels which Operate in Fixed-Satellite Service Networks in the Bands 3700-4200 MHz and 5925-6425 MHz, WRC-2000, Resolution 82 (Resolution 82) (noting "that ESVs may operate in FSS networks in the bands 3700-4200 MHz and 5925-6425 MHz under No. 4.4 of the Radio Regulations and shall not claim protection from, nor cause interference to, other services having allocations in the band").

[23] *See Example Approach for Determination of the Composite Area Within Which Interference to Fixed Service Stations from Earth Stations on Board Vessels When Operating in Motion Near a Coastline Would Need to be Evaluated*, (visited Dec. 13, 2004) <http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-SF.1585> (ITU-R Recommendation SF.1585); *The minimum distance from the coastline beyond which in-motion earth stations located on board vessels would not cause unacceptable interference to the fixed service in the bands 5925-6425 MHz and 14-14.5 GHz*, (visited Dec. 13, 2004) <http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-SF.1650> (ITU-R Recommendation SF.1650); *Guidance for Determination of Interference from Earth Stations on Vessels (ESVs) to Stations in the Fixed Service When the ESV Is Within the Minimum Distance*, (visited Dec. 13, 2004) <http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-SF.1649> (ITU-R Recommendation SF.1649); *ITU-R Recommendation SF.1648 Use of Frequencies by Earth Stations on Board Vessels Transmitting in Certain Bands Allocated to the Fixed-Satellite Service*, (visited Dec. 13, 2004) <http://www.itu.int/rec/recommendation.asp?type=products&lang=e&parent=R-REC-SF.1648.> (ITU-R Recommendation SF.1648).

[24] ITU RR 5.457A (WRC-03).

[25] ITU RR 5.457A references ITU-R Resolution 902 (WRC-03), which specifies in Annex 1 that any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s). *See* ITU RR 5.457A (WRC-03). ITU Recommendation 37 recommends operational procedures for ESV use that could help achieve such agreements. *See Operational procedures for ESV use*, The World RadioCommunication Conference (Geneva, 2003) (ITU Recommendation 37) Annex 1.

[26] ITU-R Resolution 902 (WRC-03) Annex 1 and Annex 2.

Regulations also encouraged administrations to cooperate with each other in reaching agreement on the use of ESV systems.[27] The final Conference language states that national practices, as well as applicable Recommendations of ITU-R, may be used in reaching frequency usage arrangements.[28]

C. ESV Notice of Inquiry

9. The Commission sought comment on issues surrounding the allocations for and licensing of ESVs in a *Notice of Inquiry* in 2002.[29] The *Notice of Inquiry* focused on portions of the C- and Ku-bands that can best accommodate ESVs and on how to prevent interference to terrestrial FS licensees.[30] Response to the *Notice of Inquiry* indicated general support for operations in both the C- and Ku-bands as well as for the recommendations developed by the ITU-R.[31] Some parties responding to the *Notice of Inquiry* indicated that aspects of the ITU Radio Regulations were too restrictive, specifically, the ITU Radio Regulations regarding offshore coordination distances of 300 km for C-band. These parties also contended that the 125 km coordination distance identified in the ITU Radio Regulations for Ku-band is greater than necessary for ESV operations in the United States because of particular characteristics of FS and FSS operations in the United States.[32] The Fixed Wireless Communications Coalition (FWCC) opposed the licensing of ESVs in the C-band because of concerns about the potential for ESVs to interfere with and affect the growth of FS systems.[33] The FWCC urged the Commission to abandon any further authorization of in-motion ESV operations in the C-band within 300 km of the U.S. coast or FS offshore installations such as the Gulf of Mexico or alternatively, to adopt a rigorous regulatory regime that would prevent interference from ESV operations and include mechanisms to identify the interfering source so that the interference could be quickly eliminated.[34]

D. ESV Notice of Proposed Rulemaking

10. In November 2003, the Commission adopted the *ESV NPRM* to promulgate regulations for U.S.-licensed ESV operations.[35] The Commission proposed to adopt a footnote to the U.S. Table of Frequency Allocations in the C-band that states that ESV use shall not cause harmful interference to, claim protection from, or otherwise impose constraints on the operation or development of other

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[27] ITU-R Resolution 902 (WRC-03).

[28] ITU-R Recommendation 3737, Annex 1.

[29] *Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in Bands Shared with Terrestrial Fixed Service*, IB Docket No. 02-10, Notice of Inquiry, FCC 02-18, 17 FCC Rcd 2646 (2002) (*Notice of Inquiry*).

[30] *Id.* at 2650-55, ¶¶ 15-32.

[31] *See, e.g.*, MTN *Notice of Inquiry* Comments at 10 (filed May 10, 2002); Boeing *Notice of Inquiry* Comments at 3 (filed May 10, 2002); Intelsat *Notice of Inquiry* Comments at 2 (filed May 10, 2002) (Intelsat NOI Comments); Inmarsat *Notice of Inquiry* Comments at 4 (filed May 10, 2002) (Inmarsat NOI Comments); SIA *Notice of Inquiry* Comments at 3 (filed May 10, 2002).

[32] MTN *Notice of Inquiry* Reply at 20 (filed June 10, 2002); Inmarsat NOI Comments at 5-6; Intelsat NOI Comments at 4.

[33] FWCC *Notice of Inquiry* Comments at 2-3 (filed May 10, 2002).

[34] *Id.* at 13-14.

[35] *Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, IB Docket No. 02-10, Notice of Proposed Rulemaking, FCC 03-286, 18 FCC Rcd 25248 (2003) (*ESV NPRM*).

allocated radio services operating in the C-band.[36] With respect to ESV operations in the Ku-band, because of the light use of the 11.7-12.2 GHz band by terrestrial services, the Commission proposed to adopt a footnote to the U.S. Table of Frequency Allocations that clarifies that ESV operations in that band are considered an application of the FSS and subject to the same regulatory status as other FSS operations.[37] Additionally, the Commission also sought comment on whether to adopt a 2.4 megahertz bandwidth limitation per Earth station or per satellite and whether to adopt the limitations on maximum e.i.r.p. spectral density towards the horizon and maximum e.i.r.p. towards the horizon that the WRC-03 adopted.[38] The Commission sought comment on certain conditions and restrictions on ESV operations including: a minimum distance from the coast of 300 kilometers for C-band operations;[39] a method for determining what and where the ships are at any given time;[40] antenna specifications;[41] limits on the maximum ESV transmitter power;[42] license terms;[43] and methods, where applicable, for prior coordination between ESV and fixed service operators.[44]

11. In response to the *ESV NPRM*, nineteen parties filed comments and thirteen parties filed replies.[45] As discussed in more detail below, commenters involved with the satellite community generally support ESV use of the C-band, while commenters involved with the FS community generally oppose ESV C-band use near the U.S. coastline. All commenters support Ku-band use.

III. DISCUSSION

A. ESV Operations in the Two-Degree Spacing Environment

12. Before discussing requirements of operation in each band, we address an issue that has implications to both bands. Authorizing ESVs (essentially a mobile service) in the C- and Ku-bands (which are conventional FSS bands) presents the challenge of protecting other FSS satellites from the mobile unit's potential harmful interference. To meet that challenge, this *Report and Order* adopts specific off-axis e.i.r.p.-density rules for ESV operations in both the C- and Ku-bands.

13. Generally, U.S.-licensed GSO FSS satellites are spaced two degrees apart along the geostationary orbit.[46] Spacing satellites this closely requires stringent limits on the power density emitted

[36] *ESV NPRM*, 18 FCC Rcd at 25267, ¶ 46.

[37] *Id.* at 25265, ¶ 41.

[38] *Id.* at 25255, ¶ 16.

[39] *Id.* at 25277, ¶ 74.

[40] *Id.* at 25285-86, ¶ 94.

[41] *Id.* at 25278, ¶ 76.

[42] *Id.* at 25283, ¶ 86.

[43] *Id.* at 25285, ¶ 92.

[44] *Id.* at 25275-82, ¶¶ 69-83.

[45] In addition, five parties filed *ex parte* letters after the formal pleading cycle closed. For the complete list of commenters, see Appendix A.

[46] In 1983, the Commission established a two-degree orbital spacing policy to maximize the number of in-orbit satellites serving the United States in either the C-band or the Ku-band. *See Licensing of Space Stations in the Domestic Fixed-Satellite Service and Related Revisions of Part 25 of the Rules and Regulations*, CC Docket No. 81-704, Report and Order, FCC 83-184, 54 Rad. Reg. 2d (P & F) 577 (1983); *summary printed in* Licensing Space (continued....)

from an earth station antenna towards satellites other than the target satellite.[47] The Commission established technical rules to govern earth stations communicating with satellites at two-degree orbital separations to ensure that their operations do not cause unacceptable interference to other satellite systems. The power density emitted in directions other than towards the target satellite is known as off-axis e.i.r.p.-density (or "off-axis power-density"). The higher the off-axis power density, the greater the chance for interference to neighboring satellites. Within our rules in the C- and Ku-bands, these off-axis e.i.r.p.-density limits have been expressed, heretofore, as various combinations of allowable earth station antenna patterns (*e.g.*, diameter or gain levels) and separate limits on the power-density fed to the Earth station antenna.[48]

14. In an effort to combine the ESV mobile environment with the FSS, we advance the concept of two-degree spacing for the GSO FSS by directly adopting off-axis e.i.r.p.-density rules for ESV earth station transmitters. We note that the ITU-R has adopted off-axis e.i.r.p.-density limits for both C- and Ku-band ESV transmitters,[49] and that within the record of this proceeding, Boeing has proposed off-axis e.i.r.p.-density rules for Ku-band ESV operations.[50] We agree with Boeing that adopting off-axis e.i.r.p.-density rules, as opposed to adopting multiple operating restrictions that accomplish the same objective, is the proper approach to ESV regulation. We arrive at this decision because, in addition to providing simpler service rules, this approach also provides maximum flexibility to ESV operators in implementing the two-degree spacing limits. For example, an ESV operator will now have the option of using an antenna that may not meet the two-degree spacing antenna pattern specified in Section 25.209 of our rules,[51] as long as the power-density into the antenna is reduced to the point that the off-axis e.i.r.p.-density limits are still met. This, in turn, will provide the ESV operator with a wider option of antennas that may be used to implement service. Meeting the twin goals of increasing operator flexibility, while adopting simpler service rules, leads us to adopt off-axis e.i.r.p.-density rules for ESV operations at both C- and Ku-bands, and is the guiding principle underlying many of our decisions herein. In the respective

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Stations in the Domestic Fixed-Satellite Service, 48 Fed. Reg. 40,233 (Sept. 6, 1983), *on reconsideration, Licensing of Space Stations in the Domestic Fixed-Satellite Service and Related Revisions of Part 25 of the Rules and Regulations*, CC Docket No. 81-704, Report and Order, FCC 84-487, 99 FCC 2d 737 (1985). At that time, the Commission began assigning adjacent in-orbit satellites to orbit locations two degrees apart in longitude, rather than the three-to-four degrees longitude previously used.

[47] Depending upon the type of system implemented, there may also be limits on the emissions coming from the satellite in order to comply with the two-degree spacing regime.

[48] *See, e.g.*, 47 C.F.R. §§ 25.134, 25.209, 25.211, 25.212. *See also Routine Licensing of Earth Station in the 6 GHz and 14 GHz Bands Using Antennas Less than 9 Meters and 5 Meters in Diameter, respectively, for Both Full Transponder and Narrowband Transmissions*, Declaratory Order, 2 FCC Rcd 2149 (Com. Car. Bur. 1987), *cited in* 47 C.F.R. § 25.134.

[49] *See* ITU-R Resolution 902 (WRC-03), Annex 2. As discussed in the respective C- and Ku-band sections, the ITU-R limits do not conform to our two-degree spacing regime, as they are based on satellites spaced three degrees apart. We therefore do not adopt the ITU limits, but rather use them as guidance for off-axis e.i.r.p. limits geared toward the more stringent two-degree spacing environment.

[50] *See* Boeing Reply, Attachment 1. We also note that Boeing suggested only off-axis e.i.r.p.-density limits for co-polarized transmissions within three degrees along the geostationary arc. The complete set of off-axis e.i.r.p.-density limits that are required for the two-degree spacing regime, however, also include cross-polarized off-axis e.i.r.p.-density and co-polarized off-axis e.i.r.p.-density in directions away from the geostationary arc.

[51] 47 C.F.R. § 25.209.

C- and Ku-band sections below, we discuss specific C- and Ku-band off-axis e.i.r.p.-density limits required to protect FSS satellites operating in a two-degree spaced environment.[52]

B. C-Band Operations

15. The C-band, which includes the downlink at 3700-4200 MHz (or 4 GHz) and the uplink at 5925-6425 MHz (or 6 GHz), is allocated to FS and FSS on a co-primary basis.[53] In this section, we discuss the reasons we are authorizing ESV operators in the C-band and set forth the requirements ESV operators must comply with in the C-band uplink to protect FS operations from harmful interference, including coordination and spectrum, satellite, and power limits. We also adopt requirements to help facilitate interference investigations by the FS community, such as requiring ESV operators to track ESV-equipped vessels and maintain data for use in identifying possible interference sources. We also adopt requirements to protect the FSS satellite as well as more general requirements such as minimum vessel size for ESVs. Finally, we address the regulatory status for C-band ESV uplink and downlink operations.

1. ESV Use of the C-Band

16. We adopt our proposal in the *ESV NPRM* to allow ESV communications in the C-band, subject to certain limitations imposed to protect existing FS and FSS providers in the C-band.[54] We find that licensing ESVs in the C-band would serve the public interest by enabling ESV operators to provide a variety of broadband services to consumers traveling on vessels.[55] In particular, we agree with commenters that ESV-based communications in the C-band are more accessible and reliable than in the Ku-band.[56] C-band coverage extends to very large portions of the Earth's surface, including ocean areas,[57] and communications in the C-band do not suffer as much from the weather-related attenuation that often occurs in areas of high ESV use, such as the Caribbean and the Gulf of Mexico.[58] According

[52] In the respective C- and Ku-band sections below, we also address a number of related off-axis e.i.r.p. limits, including limits on co- and cross-polarized transmissions, and transmissions toward and away from the geostationary orbit, required to provide full protection of FSS operations.

[53] 47 C.F.R. § 2.106.

[54] *ESV NPRM*, 18 FCC Rcd at 25266, ¶ 43.

[55] *See* MTN Comments at 4, 8; Telenor Reply at 6-7.

[56] *See, e.g.*, MTN Comments at 6-9; Stratos Comments at 9-10; Broadband Maritime at 2-3; Telenor Comments at 3-6; SES Americom Comments at 2-3; Inmarsat Comments at 17; Pinnacle Comments at 2; Intelsat Comments at 4. *See also* Intelsat Reply at 1-2 (disagreeing with FWCC's opposition to ESV use of C-band within 300 km of the U.S. coastline).

[57] *See, e.g.*, Broadband Maritime Comments at 2; SES Americom Comments at 3 (acknowledging that, although it is building a satellite that will increase Ku-band coverage of the Pacific Ocean, Ku-band spectrum will be less desirable to ESV operators in the short-term); Telenor Comments at 4. According to Telenor, Ku-band use increases the operating costs for ESV-equipped vessels. For example, if a vessel that requires broad coverage uses the Ku-band, it often must utilize capacity on two or three Ku-band beams rather than a single C-band global beam. *Id.* at 4. The change in Ku-band beams requires trained staff on board and the use of additional equipment. *Id.* Stratos explains that it has military and commercial customers with a significant need for maritime broadband data services on deep-water maritime routes throughout the world, and these needs are best met using the comprehensive coverage offered by C-band satellites. Stratos Comments at 9.

[58] *See* MTN Comments at 7-8; Telenor Comments at 4-5. According to MTN, when Ku-band FSS network availability declines due to precipitation, ESV operators are unable to improve network reliability by using redundant earth stations at different geographic locations (unlike land-based operators). MTN Comments at 8.

to MTN, the C-band offers sufficient commercially-available FSS bandwidth on a global basis to accommodate the high volume of voice, data and video information that flows through ESV networks on a daily basis.[59] Moreover, we find that prohibiting ESV use of the C-band would be overly burdensome for ESV operations particularly for those ESV operators that rely heavily on the C-band for their existing ESV operations.[60]

17. We also agree with commenters who argue that switching from the C-band to the Ku-band (*i.e.*, dual band use) as vessels approach a certain distance from the U.S. coastline would be technically complex and expensive. For example, in these circumstances, ESV operators would be required to lease separate C- and Ku-band transponders to cover the same region, resulting in a higher cost service and inefficient use of spectrum.[61] Similarly, shutting down the C-band operation, pointing the ESV to another satellite, and switching to the Ku-band would not only cause an interruption of service, but might require a person trained in this aspect of ESV operations to be on the vessel.[62]

18. We disagree with FWCC's contention that ESVs should not be allowed to transmit in the C-band within 300 km of the U.S. coastline or FS offshore installations such as in the Gulf of Mexico. Specifically, FWCC argues that ESV transmissions in the C-band may harm critical FS operations, including safety and infrastructure services.[63] FWCC also contends that the C-band is important for future growth of FS and could serve as relocation spectrum for FS in the 1.9 and 2.1 GHz bands.[64] Alternatively, FWCC states that if we permit ESVs to utilize the C-band, we should adopt specific measures to protect FS operations, such as a requirement to coordinate all ESV operations in advance.[65]

19. We address FS operators' concerns in this *Report and Order* without prohibiting ESV C-band use within a specific distance from the coastline. In particular, we set forth reasonable restrictions below designed to enable ESV operators to provide their services in the C-band without

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[59] *See* MTN Comments at 6, 8; *see also* Stratos Comments at 9; Broadband Maritime Comments at 2; SES Americom Comments at 3; Telenor Comments at 3-4; Intelsat Comments at 5. In addition, Stratos states the while the C-band may be more heavily used by terrestrial service providers in the United States than the Ku-band, terrestrial service providers in other countries use both C-band and Ku-band frequencies on a primary basis. Stratos, therefore, argues that adopting policies that unduly restrict use of the C-band in favor of the Ku-band would place U.S.-licensed ESVs at a significant competitive disadvantage abroad, and undermine the United States' leadership position in advanced satellite communications services. Stratos Comments at 9.

[60] *See, e.g.*, MTN Comments at 8; Broadband Maritime Comments at 2.

[61] *See* MTN Comments at 9; Stratos Comments at 10. Stratos also argues switching satellite transponders between C-band and Ku-band could cause service interruptions, further undermining the provision of ESV services. Stratos Comments at 10.

[62] *See* Broadband Maritime Comments at 2. Broadband Maritime further contends that the time period for the switch to Ku-band operations is problematic because it would occur around the time when the ship is approaching port, which is a very critical period for communications. *Id.* at 3.

[63] FWCC Comments at 2. FWCC states that the "applications include public safety communications (such as dispatching police and fire vehicles), coordinating the movement of railroad trains, controlling natural gas and oil pipelines, regulating the electric grid, and backhauling wireless telephone traffic, among many others." *Id.*

[64] FWCC Comments at 5. Some commenters support the position taken by FWCC, which opposes ESV use of the C-band within 300 km of the U.S. coastline. *See, e.g.*, Alcatel Reply at 1; American Petroleum Institute Reply at 1; Association of Public-Safety Communications Officials-International, Inc. at 1; King County Comments at 2. *See generally* FWCC Reply at 8, 19-20, 31.

[65] FWCC Comments at 3; FWCC Reply at 2.

imposing harmful interference to FS users in that band. Should interference occur despite these safeguards, we adopt additional requirements for ESV operations to mitigate such occurrences and facilitate any investigation necessary to prevent repeated occurrences. We acknowledge that C-band FS operations include public safety and critical infrastructure users. The collective measures we adopt today should protect all of the different types of incumbent operators in that band. We emphasize that ESV operators who are unable to comply with these requirements will not be allowed to operate in the C-band.

2. Coordination Approach in the C-Band Uplink (6 GHz Band)

20. In the *ESV NPRM*, we proposed to adopt a Coordination Approach to ESV operations in the C-band. Under that approach, ESVs would be required to coordinate all operations in the C-band uplink at 5925-6425 MHz (6 GHz), and comply with additional requirements such as vessel size and recordkeeping requirements.[66] In this *Report and Order*, we adopt the Coordination Approach as modified below. We also set forth conditions on ESVs transmitting in the C-band uplink. We note that it is the ESV transmissions to FSS satellites in the C-band uplink that would pose a risk of harmful interference to FS. Therefore, most of the conditions we adopt to protect FS apply to the C-band uplink at 5925-6425 MHz.

a. Frequency Coordination

21. To utilize the C-band, stationary and in-motion ESV operators will be required to coordinate uplink frequencies with FS stations on-shore and offshore in the 6 GHz band. We find that frequency coordination is one of the essential elements for protecting FS in the 6 GHz band. Frequency coordination is a process that helps to eliminate interference between different satellite systems or between terrestrial microwave systems and satellites.[67] In addition, we agree with the National Spectrum Managers Association (NSMA), which argues that the best method for controlling interference is to prevent it in advance through interference analysis and coordination.[68] Coordination allows service providers to analyze the likelihood of harmful interference in a particular region, and, in turn, to take steps to prevent its occurrence in the first place.

b. Distance from the U.S. Coastline

22. *Background.* In the *ESV NPRM*, the Commission proposed to apply the C-band rules to ESVs traveling within 300 km of the U.S. coastline or an offshore FS installation, the distance adopted by the ITU in Annex 1 to Resolution 902.[69] The Commission sought comment, however, on whether the

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[66] *See ESV NPRM*, 18 FCC Rcd at 25275, ¶ 69.

[67] *See Glossary of Satellite Terms*, (visited Dec. 13, 2004) http://www.satnews.com/free/glossary.html#F.

[68] NSMA Comments at 16.

[69] *ESV NPRM*, 18 FCC Rcd at 25277, ¶¶ 74, 75. Resolution 902 (WRC-03) references "the low-water mark as officially recognized by the coastal States" as the point from which the seaward ESV coordination line/boundary is to be calculated. *See* ITU-R Resolution 902 (WRC-03). In the United States as well as other countries, the "low-water mark" is also known as the "baseline" or "coast line." The baseline is ambulatory and thus the reference points or "baseline points" must be adjusted from time-to-time as the baseline changes due to storms and ocean currents. The baseline points are not just the low-water marks of the mainland shore, but also include islands and "low-water elevations" (*i.e.*, natural rocks). In the United States, the Department of State Ad Hoc Interagency Baseline Committee is responsible for determining the baseline points from which the baseline is calculated. *See United Nations Convention on the Law of the Sea, Dec. 10, 1982*, 21 I.L.M. 1245 (visited Dec. 14, 2004) <http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm>. The large-scale (continued....)

distance should be shorter or longer than 300 km.[70] Specifically, the Commission asked whether the 300-km distance was too burdensome on ESV operators or overly protective for FS users.[71] In addition, the Commission sought comment on how to approach a situation in which the minimum distance from the U.S. coastline falls within the minimum distance of another country such as Canada or Mexico.[72]

23. MTN argues that the Commission should adopt a distance of 100 km from the U.S. coastline, similar to the distance the Commission adopted in the *Crescomm Order*,[73] because ESV operators have operated under these conditions "without incident of interference."[74] FWCC counters, arguing that interference from ESVs is difficult to prove because the FS operator would need to shut down its system as part of its investigation.[75] Instead, FWCC argues that we should adopt 300 km as the minimum distance from the U.S. coastline in order to "to err . . . on the side of caution."[76] Stratos and FWCC, however, express a willingness to accept less than a 300-km coordination distance requirement, as long as that distance is measured from the location of offshore FS stations.[77] The Commission did not specifically address FS offshore installations in the *Crescomm Order*.

24. *Discussion.* We require ESV operators to coordinate operations when their ESVs are within 200 km (approximately 125 miles) from the U.S. coastline.[78] Additionally, we require ESV operators to coordinate operations when their ESVs are within 200 km from FS offshore installations, such as those located in the Gulf of Mexico. As a result, we ensure that all FS operations that fall within the jurisdiction of the United States are protected from harmful interference. We do not agree with FWCC's suggestion that the coordination distance with regard to FS offshore facilities be measured from the

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charts referenced in these two Conventions are the nautical charts and publication created by NOAA's Office of Coast Survey for the U.S. (http://chartmaker.ncd.noaa.gov/).

[70] *ESV NPRM*, 18 FCC Rcd at 25277, ¶ 74.

[71] *Id.*

[72] *Id.* at ¶ 75.

[73] Specifically, in the *Crescomm Order*, the Commission restricted non-coordinated ESV operations to areas beyond 100 km from the U.S. coastline, reasoning that this distance should sufficiently protect FS operations from harmful interference in the 6 GHz band. *See Crescomm Order*, 11 FCC Rcd at 10949, ¶ 11. The Commission also allowed ESV operators to utilize the C-band on coordinated routes within 100 km from the U.S. coastline. *Id.* As discussed, *supra* Section II.A., the Commission subsequently issued STAs authorizing ESV operations in the C-band.

[74] MTN Comments at 19-20. In a later *ex parte* filing, MTN states that "coordination with stations in the Fixed Service in C-Band should not require a coordination distance any farther than 150 kilometers from shore, since the accepted propagation models and MTN's experience have demonstrated that in C-Band even 100 km is a sufficient coordination distance." *See* Letter from Raul Rodriguez, Counsel for MTN, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 02-10 (dated Dec. 1, 2004).

[75] *See* FWCC Reply at 9-10.

[76] *Id.* at 24.

[77] Stratos Reply at 11; Letter from Mitchell Lazarus, Counsel for FWCC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 02-10, at 2 (dated Dec. 8, 2004) (FWCC Dec. 8 *Ex Parte* Letter). Other commenters also suggest that the coordination distance should be measured from FS offshore operations as well as the U.S. coastline. *See* Pinnacle Comments at 5; API Reply at 5.

[78] ESV operations outside of 200 km will not be required to coordinate, and thus, will have neither the benefits nor costs of coordination.

farthest offshore facility.[79] Rather, the coordination distance we adopt today – 200 km as measured from each FS offshore facility – will adequately protect all offshore facilities.

25. We decline to take a position on whether interference has occurred previously within 100 km from the coastline.[80] We acknowledge, however, that FS operators may, in some instances, be unable to investigate incidents of interference unless they shut down their systems – an impractical solution. Given the difficulty of investigating incidents of harmful interference, we prefer to adopt a conservative distance of 200 km. We agree with those commenters who claim that 300 km is more conservative than necessary to protect FS operators,[81] and consider the success of ESV operations under the STAs referenced above as lending support for a distance that is less than 300 km. Moreover, there is minimal interference risk caused by ESVs traveling between 200 km and 300 km from the coastline. Thus, using a 300 km coordination distance (as compared to our adopted 200 km distance) would unnecessarily burden ESVs located between 200 km and 300 km from the coast while not adding to the protection of the FS. In summary, we conclude that adoption of a 200-km distance should satisfy concerns about possible harmful interference to FS stations without being either overly conservative or overly burdensome. Although we recognize that an appropriate coordination distance may more easily be determined once ESV operators gain more experience coordinating frequencies with FS operators, as some commenters suggest,[82] we will only reexamine the 200-km distance should it become necessary.

c. Coordination Methodology

26. *Background.* For more than 30 years, providers of FSS and FS have coordinated their operations in order to avoid interference with each other in the C-band. In order to coordinate with fixed earth stations, FSS providers initially calculate coordination contours, which define the area within which the detailed coordination with fixed systems must occur. These contours are developed by first selecting a specific azimuth from the Earth station. This azimuth is then used to calculate the worst-case distance from the Earth stations to a fixed receiver where interference may possibly occur. This calculation is repeated at various azimuths around the Earth station and the resulting "worst case" distances are then connected to form a "coordination contour" around the Earth station. This process is used to eliminate from consideration all FS receivers outside of the coordination contour and, therefore, to reduce the number of detailed calculations that must be made to ensure that interference will not occur.

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[79] *See* FWCC Dec. 8 *Ex Parte* Letter at 2.

[80] *Compare* Letter from Raul Rodriguez, Counsel for MTN, to Marlene H. Dortch, Secretary, FCC IB Docket 02-10 (dated Dec. 8, 2004) (MTN Dec. 8, 2004 *Ex Parte* Letter), at 1 (arguing that despite the Commission's specific request for parties to provide examples of interference, no example of real or alleged ESV to FS interference appears in the record generated by the *ESV NPRM*) *with* FWCC Reply at n.15 (recounting a possible incident of ESV interference to FS communications in the vicinity of Newport News, VA that FWCC had placed in the record generated by the *Notice of Inquiry*).

[81] For instance, Inmarsat contends that this distance will "over-protect the majority of fixed links which operate in areas of more benign propagation characteristics and with less sensitive technical characteristics." Inmarsat Comments at 21. *Accord* MTN Comments at 19; Telenor Comments at 5. Indeed, in adopting a 300-km distance, the ITU used interference criteria under the worse case interference-to-noise ratio that must be met while the FS link is undergoing a 24 dB fade. A fade is a natural phenomenon that occurs occasionally within most fixed systems where the wanted signal undergoes a large drop in magnitude because of changes in atmospheric propagation. Significantly, when calculating the minimum distance from the coast in which an ESV could cause interference to a fixed receiver, the ITU took into account an FS receiver located at the low-water mark pointing directly out to sea. *See* ITU-R Rec. SF.1650.

[82] FWCC Reply at 24; Inmarsat Comments at 21. *See also* AAR Reply at 3; API Reply at 5; NSMA Reply at 2.

27. Coordination for ESVs differs from the standard coordination process for fixed Earth stations because the mobility of the ESV adds another dimension to the development of a coordination contour. Instead of developing a coordination contour from a single point, representing the location of a fixed Earth station, a contour must be drawn around the entire area in which an ESV is expected to travel. When traversing from open sea to inland waterways, large vessels are usually confined to known sea-lanes and channels. When the vessel is in a harbor area, it is confined to specific traffic lanes, turning areas and dock areas. These channels, sea-lanes, and dock areas that confine the vessel's motion are collectively the vessel's total operating area when it is near the coast.[83] This operating area encompasses all of the possible paths that the vessel may take while traveling between the ocean and the dock. The outer boundary of the operating areas is termed the "operating contour."

28. The ITU recommended the Composite Area (CA) and Critical Contour Point (CCP) methods to establish coordination contours around a vessel's operating contour.[84] Under the CA method, coordination contours are developed for every point on the vessel's operating contour and then combined to form a "composite coordination area."[85] The CCP method identifies the worst-case points on the vessel's operating contour, from the perspective of potential FS interference; develops a coordination contour around each of these critical points; and combines the individual coordination contours to create a composite coordination area.[86] Under both approaches, the individual coordination contours used to make up the composite coordination contour are calculated as though a fixed Earth station were located at the points of interest. The ITU is working on a third approach called the "Path Integration Approach," that takes the vessel's expected speed into consideration when determining the effect on the FS receiver.[87]

29. *Discussion.* The ITU coordination methods described above should prevent interference to FS operators. Specifically, through simultaneous coordination of all of the paths that the ESV might be expected to take, the ITU coordination methods should reduce the concerns flagged by FWCC that sharing the band with ESVs makes coordination difficult due to ESVs' mobile nature.[88]

30. Because the ITU has developed two different, but acceptable, approaches to coordinating ESVs and fixed services and, in fact, is working on developing a possible third approach, we allow the coordinating parties to agree on a particular coordination method.[89] We encourage ESV operators and

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[83] At distances from the coast where these well marked deep-draft channels end, or if the vessel travels parallel to the coast, but within 200 km of the U.S. coastline or an offshore FS installation, an ESV operator will have to define the operational contour that encompasses all the areas that includes the possible paths the vessel will travel.

[84] *See* ITU-R Recommendation SF.1585; ITU-R Recommendation SF.1649.

[85] The sum of all of these individual coordination contours is known as the "Composite Coordination Area."

[86] *See* NSMA Comments at 8.

[87] *See* ITU-R SF.1649, Annex 3. In effect, this approach utilizes the length of time the vessel spends near the mainbeam of the FS antenna to determine the potential for unacceptable interference in the fixed system. Although this approach has potential, it has not been adopted at this point by the ITU as part of a recommended approach to determining the coordination contour for a vessel's operating area.

[88] FWCC Comments at 6.

[89] Rather than incorporate ESV coordination rules into Section 25.203 of our rules as discussed in the *ESV NPRM*, 18 FCC Rcd at 25276, ¶ 72, we rely on the coordinators to select the appropriate ITU method at the time of coordination. We emphasize that once a coordination contour or composite coordination contour has been determined around the vessels operating area, calculations must be done to determine if any fixed system within the contour will receive unacceptable interference from the ESV transmitter. If unacceptable interference is found, just (continued....)

frequency coordinators to utilize the CCP method for identifying those FS stations that potentially could receive interference from ESVs.[90] We prefer the CCP approach because it requires fewer computations than the CA method. In particular, the CCP approach identifies a relatively small set of critical geographic points in order to develop the composite coordination area.[91] As a result, the CCP method should be less costly to use. In addition, based on the record, the CCP method has proven to be reliable for analyzing potential harmful interference from ESVs. The NSMA endorses the CCP method and states that "all in-motion ESV frequency coordination notifications to date" have relied on this method.[92]

31. Although we decline to adopt a specific coordination method, we encourage ESV operators and frequency coordinators to coordinate ports, waterways and maritime channels cooperatively and perhaps collectively to ensure efficient use of the spectrum. Once an ESV assignment is coordinated relative to FS in a given area, ESV operators could then coordinate with one another as necessary to share the assignment in frequency, time, or both.[93] We envision the ESV operators working cooperatively to share and minimize the amount of spectrum needed to be coordinated in each port by informing the coordinators of the ESV technical parameters and the amount of spectrum needed for their fleets in each accessed port, and if appropriate, dividing the relevant costs among themselves.[94] The coordinators could then evaluate the needs of multiple ESV operators and notify the operators if mutually beneficial agreements were possible.

32. In defining the coordination area, we do not require coordinators to account for FS stations that may be installed offshore subsequent to coordination.[95] Such a requirement would not only be unduly burdensome for ESV operators attempting to coordinate, it is inconsistent with the normal coordination process which requires new entrants to protect incumbent users. Furthermore, setting aside spectrum for future stations would mean that some spectrum would lie fallow for potentially lengthy periods of time. Finally, our rules described below, which limit the amount of spectrum that can be coordinated for ESVs in one location, should adequately ensure that additional offshore FS stations can be coordinated into these bands in the future.[96]

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as in a standard coordination, the ESV operator will either have to avoid the FS frequency or negotiate with the FS operator to reach a mutual coordination agreement.

[90] *See ESV NPRM*, 18 FCC Rcd at 25278-79, ¶¶ 76, 77.

[91] The points selected satisfy one or all of the following criteria: (1) any point where the ESV route changes direction (termed a "breakpoint"); (2) points where any vector from an FS receiver antenna intercepts the operating contour; (3) points on the operating contour that are within 10 dB of the main beam of an FS antenna; and/or (4) any point on the operating contour from which the maximum horizon gain of the ESV antenna is directed toward an FS receiver.

[92] *See* NSMA Comments at 2, 8-9. Stratos also supports the CCP method. *See* Stratos Comments at 15.

[93] For this purpose, coordinators and ESV operators could establish a range of parameters, *e.g.*, "up to value x," or "not to fall below value y." This could allow ESV operators to establish a broadband "gateway" into each port, while establishing certainty among the coordinators, ESV operators, and incumbent FS licensees on each path's exact boundaries. This will also provide guidance to additional operators that subsequently attempt to utilize the same path into a port at values within the coordinated range.

[94] For example, recoordination of ports could be done at intervals to coincide with transponder contracts, *i.e.*, ESV operators could lease satellite transponders on a yearly basis at less expense than occasional use contracts for ships that will be using the satellite for most of the year.

[95] *But see* Stratos Comments at 16 (arguing that the Commission should account for future offshore FS stations).

[96] *See infra* Section III.B.2.f.

d. Public Notice of ESV Coordination

33. To ensure that coordination information is readily available to all interested parties, the details of the coordination shall be maintained and available at the frequency coordinator, and shall be filed with the Commission to be placed on Public Notice. Operation of each individual ESV may commence immediately after the Public Notice is released that identifies the notification sent to the Commission. Continuance of operation of that ESV for the duration of the coordination term shall be dependent upon successful completion of the normal public notice process. If any objections are received to the coordination prior to the end of the 30-day comment period of the Public Notice, the licensee shall immediately cease operation of that particular station until the coordination dispute is resolved and the ESV licensee informs the Commission of the resolution.[97]

e. Interference Objective

34. *Background.* In the *ESV NPRM*, the Commission sought comment on whether to apply short-term or long-term interference objectives to ESVs in-motion.[98] An interference objective is a maximum permissible level of interference power density in a receiver that should not be exceeded for more than a specific percentage of time. The FS typically uses two different interference objectives: short-term and long-term. During the coordination process, these objectives, or any other interference objective that is acceptable to all parties, may be used. The goal of coordination is to ensure that the interference power density received by the fixed system is equal to, or less than, the interference objective.

35. In the case of ESVs, the short-term interference objective has been used to protect an FS receiver from the relatively high levels of interference power that may occur when an ESV passes through the main beam of a receiving FS antenna. Relatively high levels of interference power may also be received when an ESV passes close to the main beam axis of the FS receiving antenna. These instances of high levels of interference power experienced by the FS receiver are very short in duration, but have a cumulative effect over time. The percentage of time associated with the short-term interference objective is a measure of the maximum percentage of time the higher levels of interference power should be permitted. The ITU maintains that short-term interference power levels for analog FS systems should not be exceeded for more than 0.01% of the year or 53 minutes during a year.[99] The ITU uses a short-term interference objective of -131 dBW/4kHz (the current U.S. standard for earth station coordination) to protect analog FS systems.[100]

36. Long-term interference is caused by the increase in background noise from multiple noise sources that are actually in view of the FS antenna. This background noise reduces the FS fade margin, causing a decline in the FS performance. The ITU defines long-term interference as interference that exists under "normal conditions," that is, occurring for more than 20 percent of the year.[101] A long-term

[97] These procedures are modeled on the C-band small aperture terminal (CSAT) coordination public notice process, 47 C.F.R. § 25.115(c)(2)(iv).

[98] *ESV NPRM*, 18 FCC Rcd at 25279, ¶ 78.

[99] *See* ITU Radio Regulations, Appendix 7, Annex 7, Table 7b (WRC-03). The ITU maintains that short-term interference power levels for digital FS systems should not be exceeded for more than 0.005% of the time or approximately 26 minutes during a year. *Id.*

[100] The ITU uses a short-term interference objective of -103 dBW/MHz (equivalent to -127 dBW/4 kHz) for digital FS systems. *Id.*

[101] *See* ITU-R Recommendation SF.1006, § 2.1.

interference objective is designed to constrain new transmitting sources from adding to the total receiver noise floor to the point that unacceptable interference occurs. The ITU recommends a long-term interference criterion of -154 dBW/4kHz.[102]

37. The record shows a range of opinions with respect to the use of interference objectives. Some commenters favor the short-term interference objective[103] or believe that the Commission should impose both short-term and long-term interference objectives.[104] The NSMA states that proponents of either short-term or long-term interference objectives support a compromise that falls somewhere between the existing interference objectives.[105] According to the NSMA, the proponents for each objective performed extensive mathematical modeling to suggest a compromise figure, but declined to recommend one.[106] NSMA further states that the appropriate interference objective for dealing with ESV-FS coordination is being developed in the ITU-R. The NSMA notes that ESVs coordinators have been using the more conservative long-term interference objective of -154 dBW/4kHz, associated with 20% of the time, in order to avoid objections by some coordinators who oppose the short-term objective.[107] MTN proposes an alternate interference objective of -145 dBW/4kHz,[108] the same value the NSMA says was tentatively agreed to by experts as a long term objective,[109] but neither party has submitted any technical documentation supporting this value.

38. *Discussion.* In light of the comments provided, we decline to adopt a specific interference objective for ESV operations.[110] First, we agree that an alternative interference objective may be appropriate, but we do not have sufficient information in the record to determine what that objective should be. Second, in the future, an interference objective for ESVs may be determined by the ITU or by other active participants on this issue. Thus, we allow the NSMA and the industry to apply existing standards and to develop the appropriate interference objective for ESVs.[111] If the ESV and FS operators are unable to agree on a particular interference objective, the Commission may consider and exercise any appropriate action within its authority. In the meantime, we encourage the coordinators to continue their efforts on this matter because an agreement on the appropriate interference objectives would benefit all of the parties involved.

f. Spectrum and Satellite Limits

39. We adopt our proposal in the *ESV NPRM* to permit each ESV operator to coordinate 72 megahertz of spectrum in the 5925-6425 MHz band per coordination location, *i.e.*, 36 megahertz uplink

[102] *Id.* (providing parameters to calculate the maximum permissible interference levels).

[103] *See, e.g.*, Pinnacle Comments at 3-4.

[104] *See, e.g.*, FWCC Comments at 15.

[105] NSMA Comments at 10.

[106] *Id.*

[107] *Id.*

[108] MTN Comments at 20.

[109] *See* Letter from Mitchell Lazarus, Counsel for NSMA, to Marlene H. Dortch, Secretary, FCC, IB Docket 02-10, Attach. at 11 (dated Sept. 30, 2004) (NSMA Sept. 30, 2004 *Ex Parte* Letter).

[110] By "interference objective," we mean the long- and short-term interference criteria recommended by the ITU in ITU-R Recommendations SF.1650, SF.1006, and Appendix 7 of the ITU Radio Regulations, for FS coordination.

[111] NSMA Sept. 30, 2004 *Ex Parte* Letter at 11.

per satellite, using at most two satellites.[112] For example, if an ESV operator has three vessels that enter port in Honolulu, Hawaii at the same time, those vessels may utilize, collectively, no more than 36 megahertz uplink on each of two satellites.[113] We decline to grant C-band ESV operators ALSAT authority, which would allow those operators to access any U.S. satellite and non-U.S. satellites on the U.S. Permitted List.[114] Requiring ESVs to utilize no more than two satellites gives individual FS operators more opportunity to find available spectrum for FS operation because ESV operators will not coordinate the full geostationary satellite arc.

40. In addition, ESV operators, collectively, are limited to 180 megahertz of coordinated spectrum for all ESV operations in any given coordination area.[115] The purpose of the 180 megahertz limit is to further guarantee that spectrum is available to FS operators, and to ensure efficient use and sharing of the 5925-6425 MHz band. The 180 megahertz aggregate coordination limit involves two components. First, the total amount of spectrum coordinated by all ESVs at any point on a waterway is limited to 180 megahertz. Second, the aggregate amount of spectrum actually encumbered by ESV operations in an FS link path shall not exceed 180 megahertz.[116] Specifying an amount of spectrum that ESVs can collectively coordinate provides a satisfactory alternative to FWCC's request that all ESV providers operate off of the same two satellites and two transponders per satellite at each port.[117]

41. The two-satellite/36 megahertz per satellite coordination measures we impose on each operator, along with the 180 megahertz aggregate coordination limit, should give both the FS and ESV communities ample access to frequencies for their present and future needs. These measures will simplify sharing between FS and ESVs, and reduce the potential for harmful interference to FS. Further, these measures assure that ESVs encumber only a portion of the C-band spectrum, guaranteeing that C-band spectrum will be available for future FS entry. ESV commenters generally seem willing to operate

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[112] *ESV NPRM*, 18 FCC Rcd at 25275, ¶ 69. This proposal derived from our query on whether ESVs could operate under conditions that were similar to CSATs. *See ESV NPRM*, 18 FCC Rcd at 25279-80, ¶ 79. We clarify that ESV operators may use the entire C-band beyond the 200 km coordination distance, *i.e.*, in open ocean areas beyond the minimum distance where terrestrial coordination is not an issue. *Accord* Stratos Comments at 13.

[113] ESV operators will not be allowed to coordinate all 72 megahertz for use with a single satellite, as requested by Stratos. Stratos Comments at 14.

[114] *See ESV NPRM*, 18 FCC Rcd at 25283, ¶ 86. Some commenters filed in support of ALSAT authority in response to the *ESV NPRM*. *See, e.g.*, Broadband Maritime Comments at 6 (supporting ALSAT authority because ESV operators may renegotiate transponder leases and change satellite providers to obtain the best price for transponder capacity without filing an application for each satellite change); PanAmSat Comments at 5 (claiming that ESVs qualifying for routine processing should receive ALSAT authority).

[115] *See ESV NPRM*, 18 FCC Rcd at 25281-82, ¶ 83 (seeking to develop alternatives that might protect FS from harmful interference and still permit operation of ESVs in the C-band).

[116] For example, a new fixed system receiver is required in a location bordered by multiple waterways. ESVs have coordinated on each of those waterways in a manner that the amount of ESV spectrum coordinated on each waterway is less than 180 megahertz. Inadvertently, however, in the fixed service link path, the total spectrum encumbered by ESVs is greater than 180 megahertz. In this case, the FS coordinator and the relevant ESV coordinator(s) should negotiate an adjustment to the ESV coordination(s) as necessary to accommodate the FS and ESV operators. In the unlikely event that the parties are unable to work out an adjustment through the coordinators, then the Commission will work to resolve the dispute in accordance with the underlying purpose of the 180 megahertz coordination limit.

[117] *See* FWCC Dec. 8, 2004 *Ex Parte* Letter at 2.

within these limits.[118] In addition, limiting the number of satellites should allow ESVs to operate geographically closer to FS operations than if ESV operators had full geostationary satellite arc access. Further, these limitations should ease the coordination process for ESV operators by reducing the coordination area. If ESVs have significant future growth, we would expect the growth to occur in the Ku-band frequencies with the regulatory structures set forth in today's *Order*. Nonetheless, if ESV operations also expand in the C-band, the Commission would work to accommodate this growth in the future.

42. Given that the spectrum and satellite limits we adopt above should satisfy the needs of ESV operators and sufficiently protect FS operations, we will not place additional restrictions on the ESV operators' ability to negotiate satellite capacity or spectrum with satellite operators. First, we decline to limit ESV operations to specific portions of the C-band. In the *ESV NPRM*, the Commission requested comment on whether ESV operators should have access only to specific portions of C-band spectrum and whether FS operators should be required to avoid that spectrum.[119] We agree with those commenters who argue that the Commission should not require ESV operators to utilize specific frequencies or restrict ESV operators to a specific block of frequencies at the C-band.[120] For example, MTN argues that ESV operators need access to any portion of the C-band in order to coordinate with FS.[121] Inmarsat concurs, claiming that limiting ESVs to a small portion of spectrum could decrease the number of FSS operators available to provide capacity, thereby subjecting ESV operators to higher rates for the transponders operating in these frequency blocks.[122] Thus, restricting ESV operators to specific frequency blocks potentially increases costs for ESV operators and could complicate the coordination of ESV services in congested ports and waterways.

43. Second, we agree with commenters who argue that the Commission should not require ESV operators to use contiguous blocks of spectrum.[123] Requiring ESV operators to utilize a contiguous block of 36 megahertz per satellite likely would limit their ability to coordinate small amounts of spectrum where necessary, which would benefit neither ESVs nor FS operators.

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[118] *See* Inmarsat Comments at 19; *but see* MTN Reply at 10 (arguing that, although it can accept the spectrum limitation, it fails to understand the need for the limitation) *and* SES Americom Comments at 3-5 (opposing the proposed spectrum limit in the C-band downlink).

[119] *ESV NPRM*, 18 FCC Rcd 25275, ¶ 69.

[120] *See, e.g.*, MTN Comments at 16-17; Stratos Comments at 13; Telenor Comments at 8 (stating that it would not oppose the limitation as long as it applies per vessel and not per service provider); Telenor Reply Comments at 9.

[121] MTN Comments at 17. MTN also argues that the Commission should not require ESV operators to use contiguous spectrum because spectrum availability varies at each port and protecting FS necessitates the use of non-contiguous spectrum. *Id.* at 16.

[122] Inmarsat Comments at 19-20. Inmarsat contends that, if the Commission does limit ESV operators to a specific C-band portion, then new FS links should not be allowed there. Inmarsat Comments at 20.

[123] MTN Comments at 16. The requirements we adopt here are substantially similar to the requirements for VSAT networks operating in the C-band. *See FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service That Share Terrestrial Spectrum*, IB Docket No. 00-203, First Report and Order, FCC 01-177, 16 FCC Rcd 11511, 11518-19 ¶¶ 13-17 (2001) (*CSAT Order*).

44. Finally, we reject a proposal by certain commenters to require ESV operators to coordinate only the spectrum they will actually use.[124] In 2000, the Commission rejected a similar FWCC proposal to require FSS earth station applicants to demonstrate actual need for spectrum in the C-band.[125] In doing so, the Commission reasoned that earth station licensees need "the flexibility to change transponders or satellites on short notice, and without having to be re-licensed by the Commission, to meet changing operational requirements."[126] Indeed, the Commission rejected FWCC's proposal even though FSS had full-band, full geostationary arc access in the C-band.[127] In this case, ESV operators must comply with satellite limits, including an aggregate 180 megahertz industry-wide coordination limit, unlike FSS earth stations in the C-band. As a result, FS operators will receive even more protection from ESVs than they receive from FSS.

3. ESV Power Limits Toward the Horizon and Minimum Antenna Elevation Angle

45. We adopt the ITU limits for maximum ESV e.i.r.p. spectral density towards the horizon of 17 dBW/MHz and maximum e.i.r.p. towards the horizon of 20.8 dBW (collectively known as "ESV horizon limits").[128] To ensure compliance with these limits, the ESV network must automatically terminate transmissions if an individual ESV exceeds the e.i.r.p. or e.i.r.p. spectral density towards the horizon limits we adopt today.[129] We find that these limits will provide more protection for FS than a

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[124] FWCC Comments at 13; NSMA Comments at 17; Pinnacle Comments at 3. FWCC adds that ESV operators should be limited to the azimuths and elevations needed to access the satellites. FWCC Comments at 12-13; FWCC Reply at 20.

[125] *FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service That Share Terrestrial Spectrum*, IB Docket No. 00-203, Notice of Proposed Rulemaking, FCC 00-369, 15 FCC Rcd 23127, 23144-47 ¶¶ 38-42 (2000).

[126] *Id.* at 23145-46 ¶ 40. Moreover, the Commission stated "that FWCC's proposal would be impractical to implement," explaining how FSS earth station applicants would need to contract for satellite frequencies "although at the time it would be unclear whether the applicant in fact could coordinate the reserved spectrum." *Id.* at 23146 ¶ 41.

[127] The Commission proposed, however, to adopt a new procedure in which the FSS earth station operator that denies a coordination request from an FS operator would need to demonstrate to the frequency coordinator: (1) actual current and recent use of the requested spectrum; and (2) any immediate use of the requested spectrum. *Id.* at 23150, ¶ 53. In a subsequent order, the Commission declined to adopt this proposal on the grounds that insufficient information was on the record to adequately address the issues, noting that both FS and FSS operators rejected the proposal to require FSS operators to demonstrate actual use in certain situations. *See FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service that Share Terrestrial Spectrum*, IB Docket No. 00-203, Second Report and Order, FCC 02-17, 17 FCC Rcd 2002 (2002) (*CSAT Second Order*), *cited in* SES Americom Reply at 4-5.

[128] ITU-R Resolution 902 (WRC-03) Annex 2. We note that, in bands shared co-equally with the FS, the ITU has additional limits on the e.i.r.p.-density transmitted towards the horizon by an Earth station and the minimum Earth station antenna elevation angle. Specifically ITU RR 21.8 specifies that, between 1 GHz and 15 GHz, the e.i.r.p. transmitted towards the horizon by an Earth station shall not exceed 40 dBW/4 kHz for antenna elevations of zero degrees or less. Assuming a flat spectrum, this limit is equivalent to an e.i.r.p. density of 64 dBW/MHz which is 47 dB higher than the limit for C-band ESVs. ITU RR 21.14 limits transmitting Earth station antenna to a minimum elevation angle of three degrees to be used for international coordination except when agreed otherwise by the concerned administrations. The ESV horizon e.i.r.p.-density limits perform the same service as ITU RR 21.14 by limiting the power transmitted in the direction of potentially affected FS receivers. Therefore, there is no need to also impose ITU RR 21.14 on ESVs.

[129] *See* Appendix B (new Section 25.204(b)).

limitation on the minimum elevation angle of an ESV transmitter. Based upon the off-axis e.i.r.p.-density limits adopted below, we determine that the e.i.r.p. density transmitted 10 degrees from the mainbeam of the ESV antenna could be greater than the ESV horizon limits. Because the horizon limits produce a horizontal transmitted power density that is lower than the power obtained by specifying a minimum elevation angle of 10 degrees, it is not necessary to adopt a minimum elevation angle limit. As a result, FS will receive more protection from the ESV horizon limits than from the 10 degree minimum elevation limits. Additionally, we note that, under Section 25.205 of our rules, all FSS Earth stations, including ESV antennas, are required to operate with an elevation angle of 5 degrees or greater unless the applicant demonstrates that a lower elevation angle is needed or that the antenna will be pointed away from the land masses.[130] We add that even if an ESV applicant applies for, and provides a showing for the use of an elevation angle lower than 5 degrees, the ESV must still meet the ESV horizon limits.[131]

46. In addition, the ESV horizon limits are an important element in protecting the FS from interference. The ESV network shall be capable of muting the ESV transmitter if the ESV horizon limits are exceeded. Specifically, if the ESV horizon limits are exceeded, the transmissions from the ESV must be automatically shut-off by the ESV network and should not be able to be overridden by an individual on the vessel.

4. Additional Measures to Protect FS Operations

47. Although coordination and interference criteria should significantly protect FS, the Coordination Approach we adopt today includes additional measures to protect FS once interference has already occurred, or in the event that the ESV travels outside of the coordinated area. Given the mobile nature of ESVs and the larger area needed for coordination, we require ESV operators to comply with some additional measures to protect FS operations. Specifically, we require C-band ESV operators to: (1) maintain vessel tracking data for one year; (2) supply the vessel tracking data to the frequency coordinator, FS operator, or the Commission within 24 hours upon request;[132] (3) have a point of contact within the United States available 24 hours a day, 7 days per week; and (4) automatically shut-off ESV operations (either at the ESV network operation center or at the ESV) should the vessel travel outside of the coordinated area within the 200 km coordination distance.

48. *Vessel Tracking Data.* We adopt the Commission's proposal in the *ESV NPRM* to require ESV operators to maintain detailed information regarding each ESV's operations.[133] Specifically, ESV network operators must maintain information on the satellite(s) that each vessel uses, operating frequencies and bandwidth used, the time of day, the vessel location (*i.e.*, longitude and latitude), the country of registry of each vessel, and a point of contact for any foreign administration of vessel registration, if applicable.[134] Although MTN supports the retention of vessel tracking data for 90 days,[135] we are persuaded by FWCC that ESV operators should be required to maintain this data for one year.[136] Retaining this data for one year provides FS operators and frequency coordinators more time to

[130] 47 C.F.R. § 25.205.

[131] *See* Appendix B (new Section 25.204(h)).

[132] *ESV NPRM*, 18 FCC Rcd at 25286, ¶ 95; *see also* Stratos Comments at 9.

[133] *See ESV NPRM*, 18 FCC Rcd at 25275, ¶ 70. *Accord* Broadband Maritime Comments at 4.

[134] *See* Appendix B (new Section 25.221(c)(1)-(2)).

[135] *See* MTN Comments at 15, 30 n.79; *see also ESV NPRM*, 18 FCC Rcd at 25275, ¶ 70.

[136] *See* FWCC Comments at 12.

investigate an incidence of interference, including the ability to search for patterns of interference as well as to review a complete cycle of annual propagation effects.

49. *24-Hour Response.* In the *ESV NPRM*, the Commission proposed that ESV operators provide the vessel tracking data to the Commission or frequency coordinator within 72 hours upon request.[137] In general, commenters support that proposal.[138] Because ESV operators should have vessel tracking data readily available, requiring ESV operators to provide a response to the frequency coordinator, FS operator, or the Commission within 24 hours is reasonable. In addition, a shorter response time will help to ensure that the FS operators are able to resolve interference problems more quickly, and potentially more effectively, than if they had to wait 72 hours for such information. We also note that allowing FS operators to request this information directly from ESV operator should facilitate investigations of harmful interference.

50. *24-Hour Contact.* We also require ESV operators to maintain a contact in the United States 24 hours a day, 7 days a week. If ESV operators were only accessible during weekday business hours, it could unnecessarily delay an investigation of interference. This requirement will facilitate the investigative process for FS operators. According to FWCC, ESV operators have consistently failed to provide information that would allow FS operators to investigate incidences of interference.[139] Under today's decision, ESV operators are required to provide information such as vessel tracking data in an expeditious manner, and thus FS operators should be able to obtain the data needed to identify and eliminate interference. As a related matter, we also require ESV operators to provide such contact information to the Commission, and the Commission will post the information on its website.

51. *Automatic Shut-Off.* Should an ESV travel outside the coordinated area, the likelihood of harmful interference to FS operations could substantially increase. Therefore, we adopt, with some modification, the Commission's proposal in the *ESV NPRM* to require C-band ESV networks to be able to shut-off automatically ESV operations (either at the ESV network operation center or at the ESV) if an ESV moves outside the coordinated area within the 200 km coordination distance.[140] We note that, depending on the coordination method used, the vessel speed could be a significant component in the coordination. When speed is used as a factor in the coordination, we require automatic shut-off when the vessel drops below the coordinated speed. We expect the frequency coordinator to decide whether a particular coordination warrants automatic shut-off when the vessel drops below a certain speed. In addition, we understand that the speed of the vessel would normally vary within different parts of the coordinated area and that the coordination would be based on the slowest expected speed in a given waterway. If this is the case, we expect the ESV operator to implement the capability to shut off ESV transmissions automatically when the vessel drops below the coordinated speed. Like the coordination requirement, an automatic shut-off requirement will be a useful tool in preventing interference to FS operators.

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[137] *See ESV NPRM*, 18 FCC Rcd at 25286, ¶ 95.

[138] *See, e.g.*, FWCC Comments at 3.

[139] *See* FWCC Reply at 9-10; Letter from Mitchell Lazarus, Counsel for FWCC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 02-10, Attach., Earth Station Vessels, Slide 6 (dated Dec. 6, 2004). According to FWCC, "[a]n ESV could cause interference sufficient to disrupt a vital FS communications link, only to move on and never be traceable as the source of the interference." FWCC Comments at 6. MTN counters that FWCC has never directly contacted MTN to request information about a potential case of interference to a FS link in the 6 GHz band. *See* MTN Dec. 8, 2004 *Ex Parte* Letter at 1.

[140] *See ESV NPRM*, 18 FCC Rcd at 25284, ¶ 88. In the *ESV NPRM*, we did not specify that the automatic shut-off would occur at the ESV network operations center.

52. We agree with FWCC to the extent that it argues that there should be an automatic shut-off mechanism if the ESV moves outside the coordinated area or falls below the coordinated speed.[141] However, we decline to adopt FWCC's proposal that each ESV be equipped with a Global Positioning System (GPS) based subsystem capable of automatically ceasing transmissions.[142] Instead, we require that the automatic (*i.e.*, not manual) shut-off capability must be under the control of the ESV network and must not be subject to manual override by an individual on the vessel. By giving ESV operators the discretion to have the automatic shut-off capability at their network operations center or on the vessel, ESV operators can implement this requirement flexibly without making major changes to their systems.[143]

53. *Real-Time Data Access*. We decline to allow FS operators to have real-time access to ESV information, including ESV vessel itinerary, satellites, frequency, and bandwidth, as proposed by FWCC,[144] particularly given our decision to require that a point of contact be available at all times. Telenor proposes, as an alternative, to have two on-line databases that are automatically updated.[145] We decline to adopt Telenor's proposal. The additional measures discussed above, such as a vessel tracking requirement, are less complicated and more reliable and efficient than Telenor's proposal.

54. *Antenna Size Limits*. As discussed further below, we do not adopt antenna size limits for C-band ESV operations.[146] We recognize that the ITU restricted antenna size in order to limit the number of vessels capable of installing ESVs, thereby reducing the potential for harmful interference to FS operators.[147] Given the mature development of the FS systems in the 6 GHz band, we agree with the ITU's justification for constraining the number of ESVs. To achieve this same purpose, however, we adopt a coordination requirement,[148] off-axis e.i.r.p.-density limits for ESVs,[149] and a vessel gross tonnage limit.[150] We find that these restrictions will significantly decrease the number of operational ESVs and accomplish the same goals as the ITU antenna size limitations.

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[141] *See, e.g.*, FWCC Reply at 3-4.

[142] *See, e.g.*, FWCC Comments at 3, 12; Letter from Mitchell Lazarus, Counsel, FWCC, to Marlene H. Dortch, Secretary, FCC, IB Docket 02-10 at Slide 7 (dated July 29, 2004). *See also* American Petroleum Institute Reply at 4; Association of American Railroads Comments at 3.

[143] Imposing an automatic shut-off requirement at the ESV is overly burdensome and unnecessarily expensive. *See* Pinnacle Comments at 5; Schlumberger Comments at 10; MTN Reply at 11; Stratos Reply at 8-9.

[144] *See* FWCC Comments at 3. *See also* Stratos Comments at 9 (arguing that such information could be made available on a confidential basis); Telenor Comments at 8-9; *ESV NPRM*, 18 FCC Rcd at 25286, ¶ 95.

[145] One database, which would be accessed by ESV operators, would contain data regarding specific FS frequencies being used at certain locations. The second database would contain particular ESV frequencies for vessels operating in a specific region, as opposed to a specific location and would be used by FS operators to investigate an incidence of interference. Telenor Comments at 9.

[146] *See infra* ¶ 56.

[147] *See* ITU-R Resolution 902 (WRC -03) considering (j).

[148] *See supra* Section III.B.2.

[149] *See infra* Section III.B.5.a.

[150] *See infra* ¶ 61.